

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Revision of Part 15 of the Commission's)	
Rules Regarding Ultra-Wideband)	ET Docket 98-153
Transmission Systems)	

COMMENTS OF ZIRCON CORPORATION

Zircon Corporation ("Zircon"), by its attorneys, hereby files these comments in the above-captioned proceeding. Zircon is a leading U.S. manufacturer of specialized tools used in construction industries and will be directly affected by the outcome of this proceeding.

BACKGROUND

Zircon manufactures a device designed to give construction contractors extremely accurate reading of the location of rebar, pipes and wiring entombed in walls and floors. It is an invaluable tool for those engaged in renovation or demolition, and will promote the safety of construction operations by identifying hidden hazards.

On June 25, 1999, the Chief, Office of Engineering and Technology granted Zircon a waiver of various sections of Part 15 of the Commission's rules to permit Zircon to market a prototype of a Ultra-Wideband ("UWB") radar device intended to provide members of the construction industry the ability to image rebar buried within concrete walls. The Zircon device operates between 200 MHz and 4 GHz at a very low emission level. The Commission, with the consent of the National Telecommunications and Information Administration, found that even though the Zircon device operates, in part, within several restricted bands, the device posed little

probability of interference and its authorization was in the public interest. The Zircon waiver is set to expire in June of 2003 or upon the adoption of a report and order in this proceeding addressing operation of the Zircon device, whichever is sooner.

The Commission has now taken the important step of proposing regulations to permit the use of UWB devices more generally, recognizing that, “UWB devices may have the capability to provide for significant benefits for public safety, businesses and consumers.” The Commission’s proposals are clearly directed toward opening the way to this new group of RF devices, while at the same time ensuring that harmful interference is not caused to licensed radio services, particularly within the restricted bands. Zircon believes that this goal can be accomplished. Clearly, UWB devices must be allowed to use the restricted bands. Indeed it is Zircon’s bedrock belief that UWB devices must use the restricted bands in order to be viable offerings. Zircon is in general agreement with the Commission’s proposals, but offers the following specific suggestions and requests clarification of several matters.

TECHNICAL CONSIDERATIONS

- Zircon is in full agreement with other commenting parties in the *NOI* that UWB devices meeting the Class B limits should be free of any licensing requirements.¹ Devices that meet the Class A limits may require special operating conditions but these too should be minimally encumbered by any licensing requirements.
- Zircon wholeheartedly supports the proposed definition of UWB as a device with a fractional bandwidth greater than 25%. Zircon also agrees that the UWB bandwidth be determined using the antenna that is designed to be used with the device.² Care must be used, however, with the monitoring antenna to correct any frequency response aberrations and, most likely, should measure narrowband emissions at a series of discrete frequency points throughout the spectrum of the device under test.

¹ *Notice of Proposed Rulemaking* (“Notice”) in ET Docket 98-153, Para. 17, released May 11, 2000

² *Id.* at Para. 21

- Zircon is somewhat confused by the Commission's definition of "fundamental emission" and believes that this key term, particularly when used in the context of UWB, must be clarified. For example, the Commission states that the fundamental emission is the same as the main lobe of a "pulsed UWB emission" yet it also says that the fundamental is calculated as $2/t$ for a "pulse modulated emission."³ The implication of these statements is that pulsed UWB and pulse modulated emissions are different and produce different types of fundamentals. But doesn't the term "fundamental" merely denote the lowest frequency in the spectrum; and isn't a pulse modulated emission really the same as a pulsed UWB emission where the impulse is dithered or modulated with information? Moreover, the $2/t$ calculation does not always describe accurately the fundamental frequency produced by antennas with significantly different frequency responses -- something which the Commission itself observes in this docket.⁴ The Commission is urged to review these terms and provide precise and consistent definitions for the industry.⁵
- Zircon notes that the Commission proposes no restriction on operations above 2GHz,⁶ but uses definitions that are unclear. Does the Commission measure above 2GHz relative to the center frequency or the -10dB bandwidth of the device?⁷ Here again, a clarification would be in order.
- Zircon has similar concerns regarding the Commission's discussion of possible UWB standards designed to approximate "background noise."⁸ The concept of background noise is not as easy to quantify as the Commission seems to suggest. Whether a UWB emission appears as background noise is entirely dependent upon the UWB system and victim receiver. For example, a simple UWB impulse radar with a pulse repetition rate of 10MHz would have discrete spectral lines spaced 10 MHz apart. To a potential victim receiver with an IF bandwidth of 2MHz, a single spectral line might fall into the IF response and would appear as a discrete CW signal, not noise. The same device dithered, however, with spectral lines spaced 9.775 kHz apart (easily done with a pseudo-random generator 1023 bits long) would produce 204 discrete spectral lines which would look like noise to the 2MHz IF bandwidth. Hence, developing a technical standard to cause UWB devices to approximate background noise may be more difficult than meets the eye.

³ Id at footnote 10

⁴ Id at footnote 52

⁵ Zircon has similar definitional concerns with other terms as well. For example the term "center frequency" is discussed on pages 8-9 of the *Notice* and Zircon generally agrees that it should be determined as the average of the upper and lower -10 dB points as long as the output is measured with the actual transmitting antenna connected the UWB device intends to use. This should be clarified by the Commission

⁶ See *Notice* at Para. 27

⁷ See *Notice* at footnote 67

⁸ See *Notice* at Para. 34

- The Commission asks for comment on the possibility of requiring through-wall UWB imaging devices to use evenly spaced discrete spectral lines as a means of avoiding the GPS frequencies.⁹ This is a double-edged sword. At higher pulse repetition frequencies, e.g. 10MHz, this can certainly be done, however, a higher PRF generates higher average power. This could preclude dithering which generates many spectral lines closer together which may fall within the GPS frequency bands. But dithering also lowers the average power over a given bandwidth. So the tradeoff is a higher power UWB with discrete lines that avoid the GPS bands or lower power UWB with dithering (and/or lower PRF's) that overlap with GPS. Zircon suggests that all issues regarding the GPS spectrum await the results of the NTIA testing that is currently under way.
- Zircon believes the Commission may have some fundamental misunderstanding of how dithering a pulse affects its line spectra and how this, in turn, may relate to the proposed test procedures, particularly those involving the use of pulse desensitization correction factors.¹⁰ A simple impulse transmitter generates a very measurable and defined set of spectral lines. However, dithering which repeats its pattern (i.e. pseudo-random) also generates a defined line spectra. Only a true random dithering would generate emissions that are noise-like. In this latter case, it makes no sense applying PDCF as no line spectra exists to measure with a spectrum analyzer. Zircon's other concern in this area involves the Commission's use of the term "duty cycle." To determine a duty cycle, the pulse width must be known because duty cycle is equal to pulse width/PRF. But determining the pulse width can be a challenge because it depends where on the pulse waveform the width is being measured -- assuming the pulse can even be monitored with an oscilloscope. So the duty cycle computation may not be as easy as it appears.
- Zircon supports the Commission's proposed average measurement technique.¹¹ Zircon also agrees that utilizing a broadband IF receiver with the output monitored in the time domain is a useful metric.¹² Its concern, however, is that there are currently very few if any registered testing facilities having this equipment. Given that UWB testing needs will be at least initially very low, there may be little initiative for test labs to procure the required equipment creating a "chicken and egg" situation for UWB manufacturers in need of suitable testing facilities for compliance testing.

Zircon has done considerable work utilizing high speed sampling oscilloscopes for monitoring of the UWB signal. It is Zircon's experience that attempting to do this without a direct connection to the emitter is difficult at best. The very low power levels used along with the choice of antenna can have a profound effect on the results. Zircon has had to maintain the separation of transmit and monitoring antennas to distances of a few inches to get any meaningful information.

⁹ Id at Para. 36

¹⁰ Id at Para. 50

¹¹ Id at Para. 50

¹² Id at Para. 52

TREATMENT OF LOW POWERED UWB DEVICES

To a large extent, Zircon's concerns revolve around power and emissions. After all, even were the Commission not to clarify its proposals or adopt optimum measurement techniques, if a UWB device transmits at very low levels, resulting in very low emissions, the Commission should have less regulatory concern. Zircon manufactures just such a device. Thus, Zircon is surprised at the Commission's suggestion of distinguishing GPR systems and through-wall imaging devices operating below 2 GHz by proposing the possibility that emissions from the through-wall devices be attenuated at least 12db below the general Part 15 limits. Indeed, the Commission dutifully has requested comment on whether even additional attenuation is necessary. These suggestions are of great concern to Zircon.

The Zircon device emits pulsed energy between 200 MHz and 4 GHz with a useful detection range of only 12 to 15 inches.¹³ Thus, its power need not be great and its resulting emissions are very low. Indeed, the emissions from the device for which the Commission granted its waiver are virtually indistinguishable from background "white noise" – and this when measured on an open field test site!¹⁴ The added attenuation of a wall or floor renders the emissions so negligible as to be of academic interest only and certainly not an interference threat.¹⁵ Indeed any further attenuation would render the device no more accurate (but admittedly of no greater inference potential) than the pointer on a Ouija board. As we noted in our comments in the *Inquiry* in this proceeding, a sample device sent to the FCC Laboratory

¹³ In order to obtain the through-wall imaging definition of the narrow objects often of concern to construction engineers, the use of frequencies below two gigahertz are absolutely necessary.

¹⁴ For this reason, it would be highly unlikely for a victim receiver in the band to recognize, much less experience interference from, the emissions of the Zircon transmissions.

¹⁵ Although it is impossible to predict the attenuation of walls of various materials and thick nesses, it is reasonable to assume that an eight inch thick concrete wall – construction practice would dictate at least this thickness – will absorb a considerable amount of RF energy. Because of the proximity of the transmitter to the wall, there are no concerns that RF energy will escape through windows, doors, etc.

shortly after the filing of Zircon's waiver petition was initially reported to be "non-functioning" by the Commission's test engineer because emissions could not be detected above the noise floor! The emissions from this device were 19db below the Part 15 limits. Requiring the emissions to start off 12 db below the Part 15 emission limits, however, would preclude the development of future devices that could not operate at such a low level, but still would pose an extremely small threat of interference. Nor can it be reasonably expected that some combination of Zircon devices, all operating at the same time, will overwhelm some proximate victim receiver. The Zircon device will be used only on construction sites and then only for the time necessary to detect hidden materials. Even in today's building boom, it can hardly be expected that the scattered, intermittent transmissions from Zircon devices will cause concern, either singly or in combination.¹⁶

Through-wall imaging systems cover a wide variety of UWB applications. Some devices, like surveillance tools, look beyond the wall. Obviously, these products will use a higher power, and, depending on the specific application, emissions may be a slightly greater concern. Zircon's products, however, only look into the wall. This is an important distinction that goes to the issue of required signal strength and conditions of operation. Still, although Zircon's devices are intended to be operated only in contact with a wall (the devices have no utility otherwise), Zircon would still oppose any requirement to use a safety switch for its surface contact devices.¹⁷ Zircon has found that to operate to best advantage, its devices require a brief "air calibration" prior to surface scanning, and a contact switch would defeat this purpose.

¹⁶ The Commission has generally taken the approach that it will not lower the power output of devices on the theory that they might be used in combination, unless there was a likelihood of such an occurrence. In its recent First Report and Order in ET Docket No. 99-231 on spread spectrum devices, the Commission rejected a proposal by Lucent that wide-band frequency hopping devices be required to reduce their output power by up to 30db because the Commission found that Lucent's interference analysis was based on the assumption that large numbers of the devices would be distributed throughout buildings. The Commission noted that, "Lucent has failed to demonstrate that such situations are very likely in practice."

¹⁷ See Notice at Para. 26

It is possible that UWB devices used for communications purposes, and thus intended to transmit into the ether at the highest permissible power over the greatest possible range, may have some interference potential to radio services operating below 2 GHz. Obviously, Zircon has made no study of such a circumstance. For its part, Zircon is concerned about what it perceives to be unwarranted concern for devices that operate below maximum permitted powers and are designed to transmit short distances into solid objects – devices designed not to communicate, but only to detect.

Zircon believes that, for all practical purposes, the Commission should not treat through-wall imaging systems with greater rigor than GPR systems. In any event, any regulation should be sufficiently flexible to account for the various types of UWB devices that may be marketed. For instance, the Commission may have different concerns about the interference potential of a through-wall imaging system, designed intentionally to operate over a range of only inches, than about the interference potential of a ground penetrating system designed to operate over a range of tens of meters.

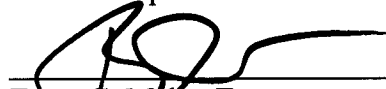
CONCLUSION

Zircon is concerned that this may be a lengthy proceeding. Surely this will be the case if the Commission waits to issue regulations until it has developed a sufficient record to address every possible use of UWB systems. But, as we have stated above, even with respect to through-wall imaging systems alone, some devices are of less inherent concern than others, and this is certainly the case when comparing all the different UWB systems that the Commission has attempted to address in the Notice.

Zircon recommends that the best way to assure the expeditious introduction of UWB devices is to address first the types of systems least likely to cause harmful interference. In some cases, such a decision need not await the results of detailed studies. It may be that that it is unwise to adopt regulations designed to apply to all GPR systems or all through-wall imaging systems. But surely very low powered devices emitting energy intended to be transmitted through absorptive substances over short distances are candidates for expedited treatment. The Commission and NTIA have already given consent to the marketing of Zircon's devices on at least a temporary basis. The sooner the Commission acts in this proceeding, the sooner the public can obtain the benefits of UWB technology.

Respectfully submitted,

Zircon Corporation

A handwritten signature in black ink, appearing to read 'Terry G. Mehn', is written over a horizontal line.

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